

What is claimed is:

1. An automatic drilling system, comprising:
  - an electric servo motor operatively coupled to a winch brake control;
  - a servo controller operatively coupled to the servo motor;
  - 5 a drum position encoder rotationally coupled to a winch drum and operatively coupled to the servo controller, the servo controller adapted to operate the servo motor in response to measurements of position made by the encoder so that a selected rate of rotation of the winch drum is maintained.
- 10 2. The system of claim 1 wherein the encoder comprises a sine/cosine output transducer.
- 15 3. The system of claim 1 wherein a winch brake operated by the winch brake control comprises a band brake.
- 20 4. The system of claim 1 wherein the selected rate of rotation is related to a selected rate of axial motion of a drill string.
- 25 5. The system of claim 1 further comprising a drilling fluid pressure sensor operatively coupled to the servo controller, the servo controller adapted to control the rate of rotation so as to substantially maintain a predetermined drilling fluid pressure.
6. The system of claim 1 further comprising a bit weight sensor operatively coupled to the servo controller, the controller adapted to control the rate of rotation so as to substantially maintain a predetermined axial force on a drill bit.
- 30 7. The system of claim 1 further comprising a logic switch selectable to conduct one or more of a plurality of control signals to the servo controller, the control signals setting the selected rate of rotation.

8. The system of claim 7 wherein the control signal comprises at least one of drilling fluid pressure, axial force on a drill bit, rate of penetration of a drill bit, wellbore inclination and wellbore azimuth.

5 9. The system of claim 1 further comprising a rate optimizer operatively coupled at an input thereof to at least one drilling operating parameter sensor, an output of the optimizer operatively coupled to the servo controller, the optimizer adapted to calculate a rate of axial motion of the drill string in response to measurements of the at least one drilling operating parameter.

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10. The system of claim 9 wherein the at least one drilling operating parameter sensor comprises a weight on bit sensor.

15 11. The system of claim 9 wherein the at least one drilling operating parameter sensor comprises a drill string torque sensor.

12. The system of claim 9 wherein the at least one drilling operating parameter sensor comprises a drill string rotation rate sensor.

20 13. The system of claim 9 wherein the at least one drilling operating parameter sensor comprises a sensor measuring a parameter related to axial position of the drill string.

25 14. The system of claim 13 wherein the axial position sensor comprises the drum position encoder.

15. The system of claim 9 wherein the at least one drilling operating parameter sensor comprises a sensor measuring a parameter related to a wellbore trajectory.

16. The system of claim 1 wherein a resolution of the encoder is about four million output increments per revolution of the drum.

17. A method for controlling a rate of release of a drill string, comprising:

- 5           measuring a parameter related to rotational position of a drawworks drum;  
          measuring a parameter related to operating position of a drawworks brake;  
          determining a rate of rotation of the drum from the rotational position related  
parameter measurement; and  
          adjusting the operating position of the brake so as to substantially maintain  
10       the rate of rotation at a selected value.

18-20. An automatic drilling system, which comprises:

- input means for setting a drawworks winch drum speed of rotation set point;  
          means for controlling the speed of rotation of the drum to match the drum  
15       speed of rotation set point.

19-21. The automatic drilling system as claimed in claim 20, wherein said means for  
controlling the speed of rotation includes a brake handle.

20-22. The automatic drilling system as claimed in claim 21, wherein said means for  
controlling the speed of rotation includes a band brake operated by said brake  
handle.

21-23. The automatic drilling system as claimed in claim 21, wherein said means for  
controlling the speed of rotation includes a servo motor coupled to said brake handle.

22-24. The automatic drilling system as claimed in claim 23, wherein said means for  
controlling the speed of rotation includes a controller coupled to said servo motor  
and to said input means.

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23 25. The automatic drilling system as claimed in claim 24, wherein said controller includes means for determining the speed of rotation of said drawworks winch drum.

5 24 26. The automatic drilling system as claimed in claim 25, wherein said controller includes means for comparing the speed of rotation of said drawworks winch drum to said set point.

10 25 27. The automatic drilling system as claimed in claim 26, wherein said controller includes a control loop coupled to said means for comparing the speed of rotation of said drawworks winch drum to said set point.

26 28. The automatic drilling system as claimed in claim 27, wherein said control loop includes a PID loop.

15 27 29. An automatic drilling system, which comprises:  
a servo motor coupled to a drawworks winch drum brake actuator;  
means for determining drawworks winch drum speed of rotation; and,  
means for controlling said servo motor based upon a difference between said drawworks winch drum speed of rotation and a speed of rotation set point.

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28 30. The automatic drilling system as claimed in claim 29, wherein said means for determining includes:  
a rotary encoder coupled to said drawworks winch drum; and,  
means coupled to said rotary encoder for calculating said drawworks winch drum speed of rotation.

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29 31. The automatic drilling system as claimed in claim 29, wherein said means for controlling said servo motor includes:  
a comparator for comparing said drawworks winch drum speed of rotation with said speed of rotation set point.

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30 32. The automatic drilling system as claimed in claim 29, wherein said means for  
controlling said servo motor includes:

5 means for setting an angular position set point for said servo motor based  
upon said difference between said drawworks winch drum speed of rotation and said  
speed of rotation set point.

31 33. The automatic drilling system as claimed in claim 32, including:

10 means for determining the angular position of said servo motor; and,  
means for comparing said angular position of said servo motor with said  
angular position set point.

Rule 1.26